Taxonomic richness of stream benthic algae: Effects of flood disturbance and nutrients

Biggs, Barry J. F., Robert A. Smith

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ABSTRACT: We sampled benthic algae monthly for 15 months in 12 New Zealand gravel-bed streams to investigate amongstream differences in algal taxonomic richness and how this might relate to among-stream differences in flood disturbance and nutrient resource regimes. The mean number of benthic algal taxa per month ranged from 9.4 to 21.3 among streams. There were moderate month-to-month fluctuations in richness, partly in response to flood disturbances. Flow perturbations generally reduced richness in streams with unarmored bed sediments but had little or no effect on richness in streams with armored sediments. Richness was moderate within days of floods in most streams but then did not vary significantly for periods of up to 50 d. However, in streams with prolonged periods without bed-moving floods, richness slowly increased after ~100 d, and, in two of these streams, it peaked at 200-300 d before declining. Unexpectedly, there was not a significant pattern in mean monthly richness among the streams as a function of annual flood frequency. Mean richness was strongly negatively related to soluble nutrient concentrations (particularly with soluble inorganic nitrogen [SIN]; $R^2 = 0.511$, $P = 0.018$). However, this was not a direct relationship, because nitrogen-fixing taxa were common in the streams with low SIN, resulting in intermediate to high mat-scale nitrogen concentrations. This possibly shifted these communities to P-limited growth. A combination of disturbance frequency and mat P gave the most parsimonious model of among-stream variations in benthic algal richness ($R^2 = 0.635$, $P = 0.037$). The highest richness occurred in streams with low to intermediate frequencies of flood disturbance (up to 10 bed-moving events yr^{-1}) and intermediate to high concentrations of mat P (>0.6% P). We could not define an upper nutrient concentration that negatively affected benthic algal richness (perhaps because none of our streams were highly enriched). We discuss our results in relation to three contemporary models of biodiversity.